JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3 1879

VOL. XXXVII NO. 6 | SAN FRANCISCO, AUGUST 5, 1916 | PER COPY, 25 CENTS

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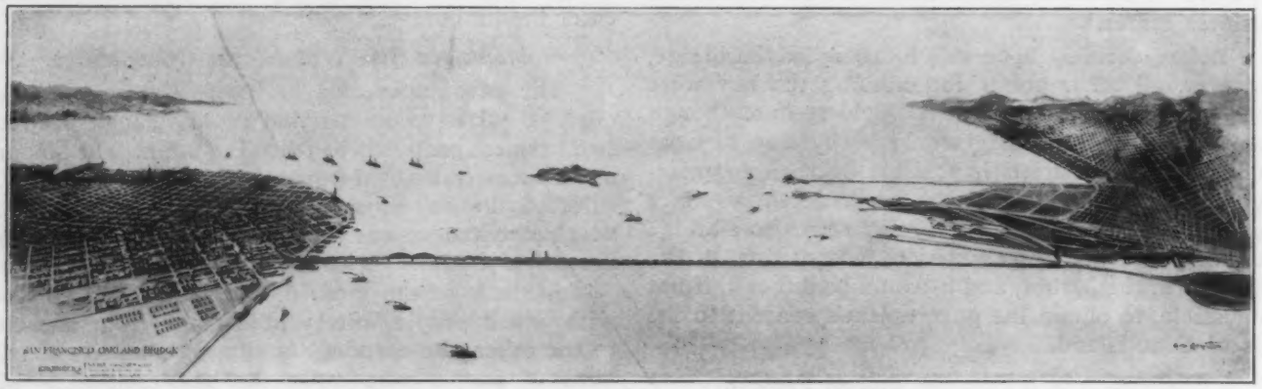

Bird's Eye View of Proposed San Francisco-Oakland Bridge.

THE PROPOSED SAN FRANCISCO-OAKLAND BRIDGE

The records show that as far back as the days of Collis P. Huntington numerous schemes for interlinking Oakland and San Francisco either by tunnel or bridge have from time to time been put forth.

During recent years, however, the rapid growth of the bay cities—Oakland, Berkeley, Alameda and San Francisco—now totaling nearly a million in population make the problem one of vast economic importance. Five ferry systems now convey the traffic from the east bay cities back and forth to San Francisco. Indeed, a careful estimate shows that over 40,000,000 people cross annually between the bay cities. The number of people passing daily through the ferry building at the foot of Market street is exceeded by but one other terminal in the world, namely, the Union Station in Paris.

Physical Features of Proposed Bridge.

The bridge that is now put forth for the earnest consideration of the various civic bodies about San Francisco Bay is to be located so that the Oakland terminal will be at First and Adeline streets and the San Francisco terminal at Second and Townsend streets.

The proposed bridge has 80 spans in its length of five and a half miles and although the spans are not of excessive length, they are very heavy. The bridge will be one of the heaviest bridges ever built, for it will carry three roadways and four railroad tracks.

The bridge will be the greatest bridge structure ever built. The main portion of the bridge is made up of sixteen spans 250 ft. long and just alike. Near the San Francisco shore there will be two very high spans under which the shipping will pass. These spans will be 600 ft. long and will be by far the heaviest and longest spans of their kind ever built. There will also be two movable spans in the bridge which will be not only the heaviest movable spans ever built, but the only ones of their kind in the world.

The bridge will be a double deck structure with the three roadways on the upper deck and four railroad tracks on the lower deck. Its capacity has been made great enough to provide for the increase in traffic for many years to come. It will have two tracks for overland passenger trains, two tracks for electric trains, two separate roadways for slow moving vehicles, one in each direction, and one wide, specially designed, boulevard-like roadway for automobiles only. The bridge will be five and one-half miles long, and could be completed within four years.

Special attention has been given to the handling of the automobile traffic. The automobile boulevard being paved with the latest type of wood blocks, the approaches having low grades and wide sweeping curves.

The grades, the curves, and the block signals for the railroad tracks have all been planned so as to allow the high speed which modern traffic conditions require.

Proposed Bridge Site Compared with Other Possible Sites.

The proposed bridge is located on the shortest line between the centers of San Francisco and Oakland. This location for the bridge was not chosen primarily however because it is the shortest route between the business centers, but because the depth of the water in the bay at the point of crossing is very shallow, and because it placed the bridge beyond ninety-five per cent of the present shipping of the bay. The starting point of the bridge in Oakland is such that all of the existing electric lines and all of the steam railroads on the west side of the bay can be easily diverted to the bridge. After crossing the bridge the electric interurban trains will be run on an elevated structure to the heart of San Francisco's business center.

Before deciding upon this location for the bridge, however, all other points for crossing the bay were considered. At first thought it would seem as though the best point of crossing would be by way of Goat Island but that route is impossible from an engineering standpoint because of the great depth of water between Goat Island and San Francisco. Also a bridge at that point would be a serious obstruction to the entrance to the harbor, and it would be difficult, if not impossible, to obtain the government's consent to the use of Goat Island.

Discussion of a Possible Tunnel Project.

Among the many schemes which have been suggested for connecting the east bay cities with San Francisco has been a tunnel under the bay. A tunnel has never been seriously considered by engineers, however, because it is impracticable and too costly, but the idea of going under the bay instead of over it, at first thought, appeals to many people who do not understand the problems connected with such construction.

A tunnel which will provide adequate facilities for handling the traffic which crosses San Francisco Bay would have to have the same capacity as the bridge which is now being considered, that is, it would have to have at least three roadways and four railroad tracks. Such a tunnel or rather series of tunnels is entirely impracticable because of the great cost which would be several times the cost of a bridge.

Possibly the greatest objection to a tunnel, however, would be the liability of an accident from earthquake. The inhabitants of San Francisco would not relish the thought of being in a tunnel under a hundred feet of water when there was even a slight earthquake.

Also there would be great difficulty in ventilating such a deep and long tunnel as would be required. So it is not thought that even could a tunnel be constructed for the same cost as a bridge that it would be popular with the people.

Bridge Would Reduce Possibility of Accidents.

The United States Government's Bulletin on the Climate of San Francisco says, "One of the most marked climatic features of San Francisco is the prevalence of fog." To the citizens on land the fog is considered one of the city's assets and "San Franciscans love their fog," but the fog is far from being an asset to the shipping interests.

In the summer these fogs move through the Golden Gate about 1 p. m. and in the winter they appear in the mornings. Frequently the fog is so dense on the water that one can see but a few feet through it. With the increase in shipping the difficulty of navigation on the bay in these dense fogs is becoming greater and greater.

The construction of a bridge which will allow the people to be carried quickly and safely across the bay on electric trains is desired not only by the traveling public but by the shipping interests as well, because it will free the bay of the numerous ferry boats of the five different ferry systems which now operate boats at right angles to the path of practically all ships which enter the harbor.

Advantages that Will Accrue from Bridge.

The advantages of a bridge to the bay cities is obvious. It is axiomatic that rapid transit between two business centers is beneficial to both. The amount of business transacted between the cities on the two sides of the bay is so great that their commercial development demands better transportation facilities, not only for passengers but for vehicles as well.

Aside from the greater ease, safety and comfort with which people will be able to go from one city to the other, the economic saving in time to the millions of people who cross the bay each year will amount to millions of dollars.

Estimated Costs.

The estimated cost of the proposed bridge is $22,000,000. It is proposed that the bridge shall be owned and controlled jointly by the two counties adjoining the bay and that a toll shall be charged to the railroads and to vehicles for the privilege of crossing the bridge. It is estimated that these tolls will pay the interest on the cost of the bridge as well as the cost of maintaining it.

The Present Status.

The plans of the proposed bridge have been submitted to the Secretary of War by the Federal Government, for approval and a board of army engineers has been appointed to hold public hearings in San Francisco and Oakland on August 15 to 18 inclusive on the plans and to report on their feasibility. This board is composed of Col. Thos. H. Rees, engineer of rivers and harbors of San Francisco, Col. Chas. L. Potter, engineer of rivers and harbors of Portland, and Major George B. Pillsbury, engineer of rivers and harbors of Los Angeles.

The plans for a bridge over San Francisco Bay which are now being considered by the communities around the bay, were prepared by Wilbur J. Watson Co. of Cleveland, Ohio, William Russell Davis of Albany, New York, and Harlan D. Miller of Oakland.

Woodrow Wilson, in his excellent essay, "When a Man Comes to Himself," says: "It is the discovery of what they can not do, and ought not to attempt, that transforms reformers into statesmen ;and great should be the joy of the world over every reformer who comes to himself.

COMPUTATION OF SKIN EFFECT FOR STRANDED CABLES.

BY CLEM A. COPELAND.

(In the issue of July 29, the author discussed the phenomenon of alternating currents persisting in flowing along the outer "skin" of the cross-section of a conductor and forsaking the central area. Formulas for numerical computations were given and numerical illustrations set forth which enable the engineer to compute this so-called "skin effect" for any size of wire or rod of solid cylindrical form composed of any non-magnetic metal at any frequency, up to say 3,000,000 cycles at any temperature. Cables, however, are composed of stranded sections. Indeed, such a section is shown in this article to materially reduce the "skin effect" under certain conditions, and is consequently to be preferred in many instances. By a similar treatment as followed in the first article the author herein shows how to compute this effect for stranded cables and by concrete illustrations sets forth comparisons of the skin effect of copper and aluminum stranded cables and also computes the skin effect for underground cables. As an interesting side-light he further shows to what extent the socalled "spirality effect," or twisting of stranded cables, enters into computations for "skin effect."—The Editor.)

Mr. Kennelly and others have very conclusively proven that the skin effect ratio for concentrically laid stranded cables is the same as would occur in a solid wire or rod having a cross-section equal to the sum of the cross-sections of the wires composing the cable, whether these wires are twisted or laid spirally or are all kept parallel and straight so long as the cable is symmetrical, i.e., composed of 7, 19, 37, 61, etc., strands symmetrically disposed around a central strand or wire, all of the strands being of the same size. This statement is practically correct for all frequencies below 1200 cycles per second.

It has also been observed that the total self-induction ($\mathbf{K_L}\ \mathbf{L_{1dc}} + \mathbf{L_e}$) of a circuit of cable has from .981 to .987 of the self induction of a like circuit of an "equivalent" solid wire, up to 5000 cycles, or so.

These differences if any, between $\mathbf{K_R}$ and $\mathbf{K_L}$ for a cable and an "equivalent" solid wire are termed "spirality effects."

Kennelly states that the skin effect may be eliminated entirely by insulating the strands of a cable from each other and at the same time transposing them so that any one strand occupies, in succession, different positions in the cross section. A cable made up of six strands wound over a hemp core, each strand being composed of three insulated wires would therefore entirely eliminate skin effect.

The "spirality effect" at high frequencies is shown by Mr. Kennelly's curves of Fig. 4 which are plotted from Table VI giving the results of tests on 7-strand copper and aluminum cables having total cross-sections of 211,600 and 211,950 cir mils respectively.

TABLE VI.

Skin Effect in No. 0000 7-Strand Copper Cable.

A_{12} Inches.	Frequency f Cycles.	Temperature, C°	Observed, K_R
24.47	60	12.0	1.005
	207	25.7	1.035
	475	27.0	1.233
	925	26.8	1.582
	1468	27.0	1.966
	2010	27.0	2.295
	3065	27.7	2.802
	3920	27.5	3.151
	5040	27.2	3.552
2.92	60	20.0	1.004
	189	12.4	1.063
	682	12.3	1.458
	1090	15.8	1.789
	1540	16.2	2.117
	2010	17.2	2.470
	3112	18.9	3.103
	3960	17.8	3.615
	5040	14.4	4.130

Problem II—Conditions:

Conductor, solid hard drawn aluminum of average purity.

Size: 750,000 cir mils.

diam. = .8660254 in.

$r_1 = .8660254''/2 = .4330127''$.

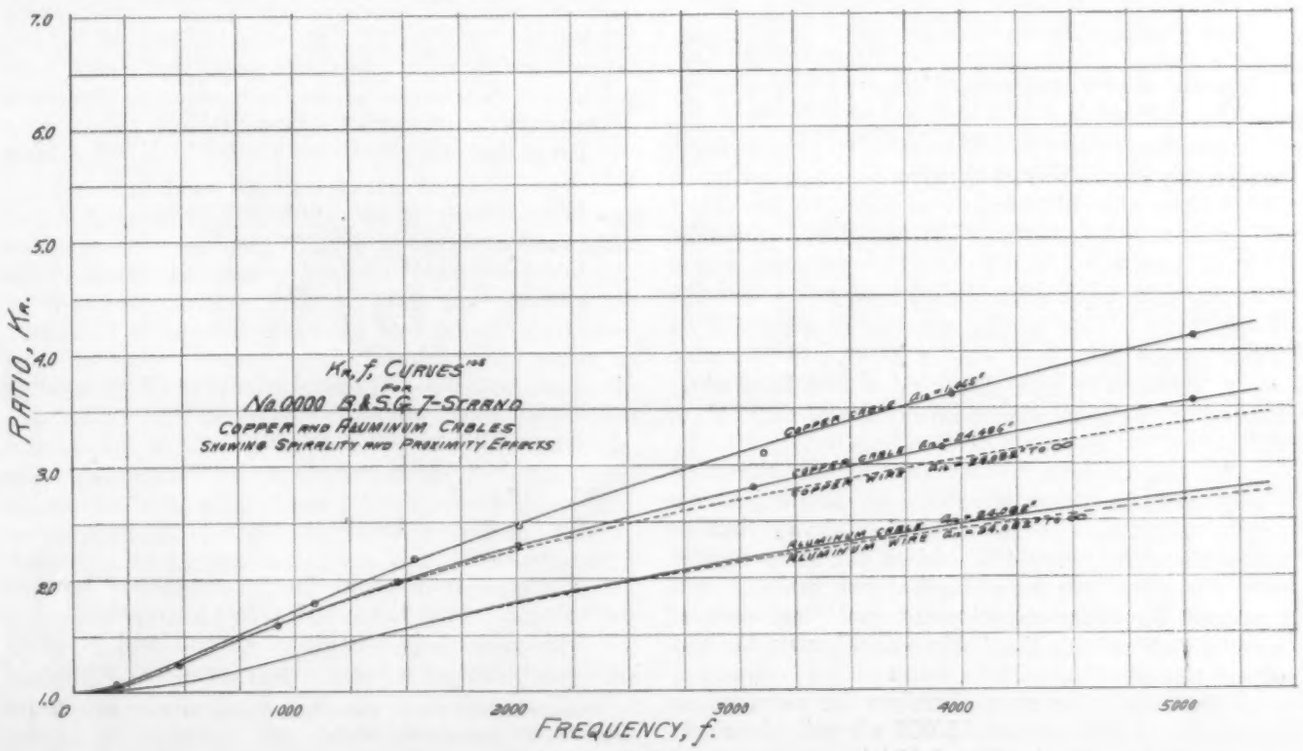

Fig. 4.

$A_{12} = 120$ in.; and therefore an absence of "proximity effect."

f = 60 cycles.

Temperature 20° C. = 68° F.

$10^9 \rho = 2828$.

$\varkappa = 22.570 \times .4330127 \sqrt{60/2828} = 1.423633$.

$K_R = 1.02105$.

$K_L = .98951$.

Found by interpolation by means of curves.

Problem III—Assume a summer temperature of wire with 144.2 amperes as 150° F. = 65.5° C.

Assume temperature coefficient of .0039 per deg. at 20° C. to hold from 20° to 65.5°.

$10^9\rho = 2828\ (1 + .0039\ [65.5° - 20°])$

$= 2828\ (1.17745)$.

$= 3329.828$.

$\varkappa = 22.570 \times .4330127 \sqrt{(60/3329.828.)}$

$= 1.31189$.

$K_R = 1.01523$.

$K_L = .99241$.

Problem IV.—We may find the size of a copper conductor for the same resistance by the "cut and try" method, thus:

$10^9 \rho$ for aluminum at 20° $= 2828 \times 1.02105$.

$= 2887.531$.

Assume as a first trial that, for hard drawn copper, at 20° C,

$10^9 \rho = 1724.1 \times 1.015 \times 1/.973$.

$= 1798.5$,

the resistance of soft copper being .973 × that for hard drawn copper.

A_{om} = Area $= 750000 \times 1798.5/2887.5$.

$= 467142.8$ cir mils.

$r_1 = .3417392$.

$\varkappa = 22.570 \times .34174 \sqrt{60/1798.5} = 1.4088$.

$K_R = 1.0202$.

Assume a new trial value of $K_R = 1.0202$.

$10^9 \rho = 1724.1 \times 1.0202 \times 1/.973 = 1807.736$.

New $A_{om} = 750000 \times 1807.736/2887.531$.

$= 469536.9$ cir mils.

$r_1 = .342613$.

$\varkappa = 22.570 \times .342613 \sqrt{(60/1807.913)} = 1.408774$.

$K_R = 1.0202$.

Thus no further trial is necessary and a 469536.9 cir mil hard drawn copper wire is equivalent to a 750000 cir mil aluminum wire at 20° C. and 60 cycles.

It is observed that this ratio would be slightly changed at the maximum temperature of 65.5° C. or 150° F.

The consideration of a cable having the same circular mils in either aluminum or copper in connection with the curves of Fig. 4, shows that no perceptible change would be made in the above figures. This statement has been further conclusively substantiated by other experiments, and the so-called "spirality effect" on the "skin effect" may be considered absent.

This calculation may therefore be accepted as correct for the 19 strand 750000 cir mil aluminum cable in the transmission line field laboratory of Stanford University. This cable has an overall maximum diameter of .999", being 1.154 larger than a solid wire of the same cross section. The largest long distance conductor at present is that of the Niagara, Lockport and Ontario Power Company on their 60000 volt line in which a 19 strand 642000 cir mil aluminum cable is used at 25 cycles.

Problem V.—Illustrating the use of Mr. Kennelley's curves of Fig. 4.

Let a 2-conductor "duplex cable" be constructed for underground distribution at 750 volts and 60 cycles, each conductor consisting of 37 strands of soft drawn copper having dimensions equivalent to

$A_{om} = 469536.9$ cir mils.

$r_{1,2} = .342613$ inches.

Thickness of varnished cambric or "var-cloth" insulation, 3/32 in.

Overall diameter of each conductor = .8104 in., being 1.182 larger than a solid wire of the same cross section. This cable will be laid with a jute filler and covered with a braided weatherproof insulation tape, etc., and not encased in a lead sheath.

For correspondence with Problem II we will assume a rather impure soft copper of $10^9 \rho = 1807.913$.

We have further,

$A_{12} = .1875 + .8104 = .9979$ of an inch.

It is desired to find K_R.

Take Kennelley's experiments Table I, on No. 0000 wire, and use his value of $K_R = 1.0038$ for $A_{12} = 24.082$ as the value of K_R for $A_{12} = \infty$, as in Formula (1) because it is evident that, by comparing this value with that at $A_{12} = 8.334$, the fourth decimal place would not have been changed by further separation.

Construct the following table:

A_{12}	Ratio $r_{1,2}/A_{12}$	K_{RA12}	K_{RP}	
∞	.00000	1.0038	1.0000	$r_{1,2} = .230$
24.082	.00955	0.0038	1.0000	
8.334	.02760	1.0058	1.0020	
2.9795	.07722	1.0087	1.0049	
.7448	.2970	1.0124	1.0086	
.46000	.5000	.....	.....	to aching

K_{RP} = Ratio $K_{RA12}/K_R\infty = K_{RA12}/1.0038$.

From this table construct a curve of $X = r_{1,2}/A_{12}$, $Y = K_{RP}$.

From this curve one finds for a ratio

$r_{1,2}/A_{12} = .342613/.9979 = .3433$.

that $K_{RP} = 1.00919$.

Finally $K_R = K_{RP} \times 1.0202$.

$= 1.00919 \times 1.0202$.

$= 1.0296$.

The smallest interaxial distance which could occur with these cables would be about

$A_{12} = .8104$ in which $r_{1,2}/A_{12}$.

$= .3426/.8104 = .4225$ at which,

$K_{RP} = 1.0195$.

$K_R = 1.0195 \times 1.0202$.

$= 1.041$.

The resistance would thus be increased 4% above the value it would have with direct currents.

This process is considered correct and probably sufficiently accurate for ordinary practical work.

(Erratum:—Table II, Page 79, of issue of July 29, refers to $10^9\rho$ and not ρ as there stated.)

(To be continued.)

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

CONSTRUCTION OF IRRIGATION CHECKS.

Where a road grader is used the blade should be at least seven feet long. This can be run lengthwise of the strips, throwing a light cutting toward the sides from the middle to form the levees. For narrow checks and small levees, this method gives better results than

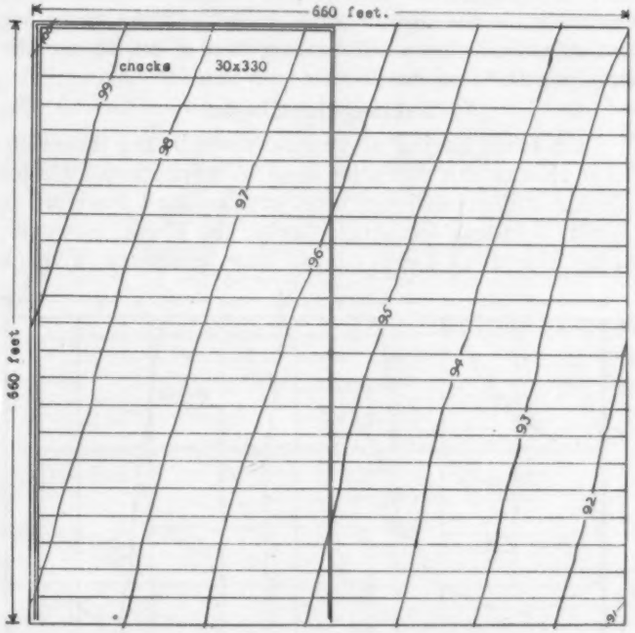

Fig. 1. Strip Checks for Ten Acre Field, Medium Light Soil, 400 Gallons per Minute Supply.

running across the checks with a Fresno and dumping on the line of the levees.

In order to grade land to advantage, the soil should be in a similar moisture condition to that needed for general plowing. Heavy soils, when dry, may break into large clods which are difficult to reduce. Such lands can best be handled in the spring or after the first fall rains, if later rains do not interfere.

How the Checks are Made.

Where small irrigating heads are used, large levees are not required. The more carefully the checks are prepared, the less will be the need of high levees, as the water will not back up on any part of the check. The present tendency is toward small, well rounded levees, which while retaining the water in the checks, do not interfere with farm operations. For heads of 1 or 2 second feet, levees which settle to a height of 6 inches are sufficient. To allow for settlement and compacting by farm machinery, such levees should be built with about 2 in. excess height. The width of the levee should be 5 or 6 ft. for these heights. After the earth for the levees has been placed, a smoother is run over them, one form of such smoother being shown in the illustration.

In levelling land, it should first be plowed. If uneven, so that much grading is required, only the knolls may be plowed at first. The heavier grading can be done before the checks are marked out. A light furrow may be run along the levee lines to mark them. The earth for the levees is then secured and the final grading and smoothing within each check completed. Before seeding, water should be run in each check to settle fills and enable the final smoothing to be made. Where much grading has been done, more than one trial irrigation may be needed. If it is necessary to irrigate the new seeding before it has become sufficiently strong to prevent washing, much care may be needed to prevent eroding the checks. This is particularly true on the steeper slopes.

The Cost Involved in Preparation of Land.

The cost of preparing land in checks varies widely. Contract costs usually include the field ditches and sometimes the structures. For very uniformly sloping smooth land, the cost of preparation may be mainly the cost of constructing the levees. Including plowing, levelling and trial irrigation, the cost under the most favorable conditions will be $3 or $4 per acre. This does not include any cost for removing native vegetation. In California the lands now being prepared for irrigation under pumping plants have nearly all been in use for grain farming, so that such clearing is not required.

For uneven land, the cost of levelling may be as high as $50 or more per acre. Such costs might be required on hog wallow lands or lands of uneven or irregular slope. For such land, the cost is necessarily high. Careful arrangement and planning of the checks may reduce it, however.

For usual conditions, the cost of levelling, exclusive of the structures, will be from $8 to $15 per acre. Many fields will cost as high as $25 per acre.

Strip Checks.

Strip, border, ribbon, or gravity checks, as they are variously called, are largely used in California practice. These consist of parallel checks, having a length of from 6 to 15 times their width. They are given a slope in the direction of their length, but are level transversely. The selection of the length and width for any given case depends on the soil, slope and crop. While all soils can be irrigated by this method, it is best suited to those which absorb water readily. For heavy soils, level checks which give areas on which the water can be ponded until absorbed give better results with less waste. By properly adjusting the size of check to the size of irrigation head, level checks can also be used on very porous soils.

Proper Heads of Water for Check Irrigation.

For irrigating heads of 2 second feet or less, the size of border checks is smaller than for general gravity supply practice. The levees can also be made of less height. For small heads, widths of greater than 50 ft. are not desirable. The best results on average soils and large heads are secured with widths adjusted, so that the flow will be equivalent to 0.08 or more second feet per foot of width. This ratio can hardly be maintained for the small irrigating heads, due to practical considerations, although it would give an efficient use of water. By using larger slopes than are practical with large heads, good practice for small heads

would be represented by the use of heads of from .03 to .05 second feet per foot of width of strip check, on rather pervious soils. This is equivalent to a flow of about 12 to 20 gallons per minute per foot width of check. For heads of 1 second foot for such pervious soils, this would give a width of 20 to 33 ft. For heads of 2 second feet, widths of 30 to 40 ft. represent good practice. On soils of medium texture, such as silt loams, somewhat greater widths might be used; on heavy soils where small heads must be allowed to run for relatively long times, in order to secure sufficient absorption, narrow widths are desirable, as it is difficult to level wide checks with sufficient care transversely to secure even distribution with such small flows.

Relative Proportions for Checks.

The length of strip check should be adjusted to the soil and head. If the irrigating heads do not exceed 1 second foot, the length should not exceed 330 ft., and less would be preferable for the lighter soils. On heavy soils, lengths up to 660 ft. are sometimes used. A reduction in the width of checks increases the number of dikes or levees in the field, and the number of turnouts from the ditches, but does not increase the number of ditches. A reduction in length of checks does increase the number of field ditches with resulting inconvenience in handling the crop. For this reason, the length of checks is often made greater than it otherwise would be. For long checks, the amount of water which must be turned into the check to cover the lower one-third of the check may be as great as that needed for the upper two-thirds. The difficulty of covering long checks is becoming better realized, and the tendency is toward the use of smaller lengths. Checks 33x330 contain one-fourth of an acre; those 40x400, three-eighths of an acre. For small heads, strip checks of over one-half acre should not be used.

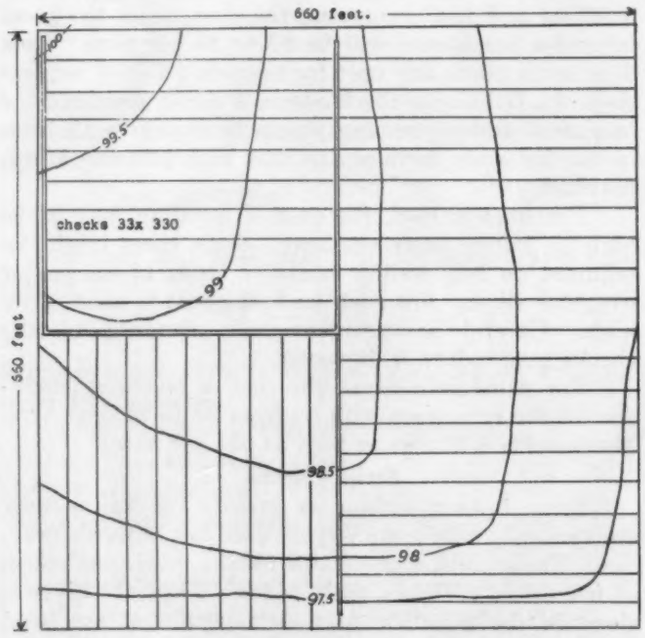

Fig. 2a. Ten Acre Field Laid Out in Strip Checks to Fit the Slope.

The slope of strip checks does not need to be uniform, and it is not usual to make it so if the slope of the land is irregular. For large heads, slopes of 2 to 4 in. with maximums of 12 in. per 100 ft. are representative of good practice. With small irrigation heads, greater slopes can be used and are desirable. After a stand has been secured, small heads can be run on slopes of 2 ft. per 100 ft. without washing, although some difficulty in irrigating the new seeding may be experienced. Steeper slopes are the most desirable on the lighter soils, however. As these are the most liable to wash, greater care must be used in handling the water.

Rectangular Checks.

On lands having no general slope in any direction, level checks can often be used to advantage. Under similar soil conditions, level checks may have areas similar to those for strip checks, the shape, however, being different. Level checks may be square; a check

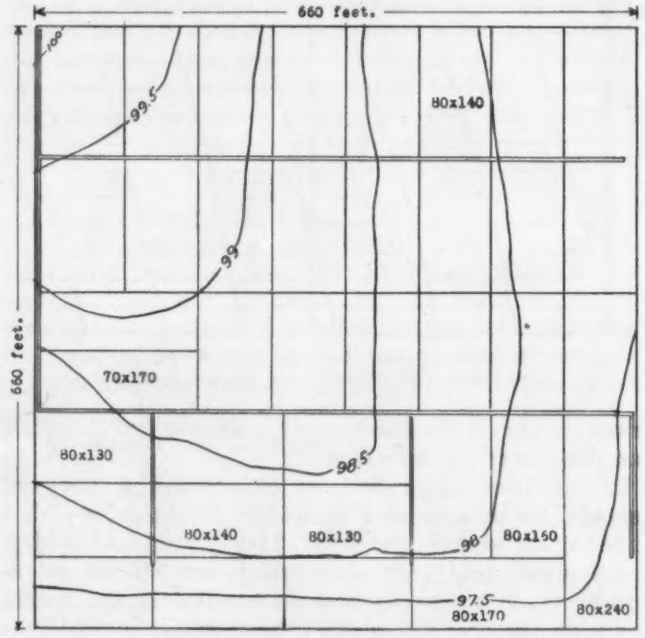

Fig. 2b. Ten Acre Field as in Preceding Figure, but Laid Out in Rectangular Checks.

200x200 ft., containing nearly an acre should not be exceeded in size even on heavy soils, unless heads of over 2 second feet are available. A check 100 ft. square contains nearly one-quarter acre. It is generally preferable to make such checks with the length about twice the width. This enables the dimension in the direction of the slope of the land to be reduced, thus reducing the amount of grading to be done. It also reduces the number of field ditches. On light soils the area of the checks should not exceed one-eighth of an acre per second foot of supply. For one second foot heads, this would give checks about 50x110, and for 2 second foot heads, checks about 75x150. On very porous soils, smaller checks than these are preferable. If the land has much slope, longer and more narrow checks may be used. While on heavy soils the rate of absorption may be sufficiently slow so that larger checks could be filled with small heads, large checks are not usually desirable. The amount of grading re-

quired for large checks is much greater than for smaller ones. If the fall of the land is one foot per 100 ft., a check 100 ft. wide requires that a maximum of 6 in. cut be made on the upper side; if only 50 ft. wide, the cut would only be 3 in. More careful levelling is needed on large checks. It is difficult to level land so that variations of 2 in. will not occur. If water has to be ponded, so as to cover a portion of a check 2 in. above the rest, the quantity required for such ponding is much greater on large than on small checks.

The methods of grading for level checks are similar to those for strip checks. Earth from the high side of one check can be placed on the low side of the check above with less haul than to carry it to the low side of its own check. Where much cutting is to be made on wide checks, this is advisable; for narrow checks, levelling within each check is more usual. While such checks are practically level, it is preferable to give a slight fall away from the turnout box. This fall should be one or two inches for small checks, being

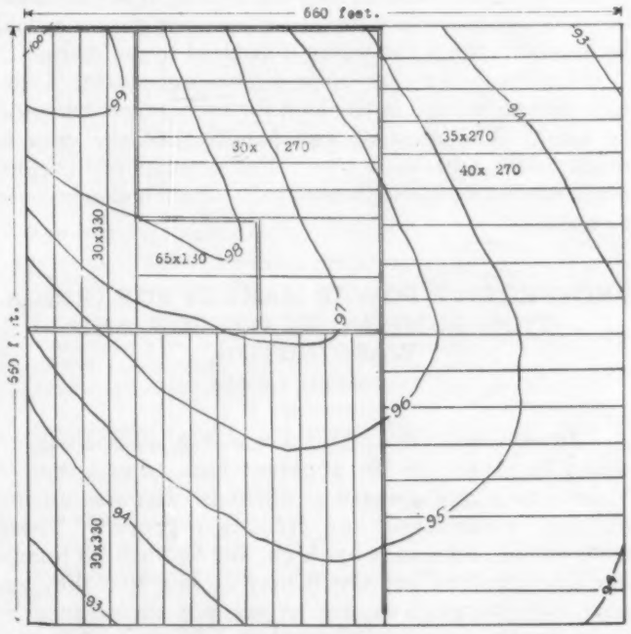

Fig. 3. Arrangement of Checks on Ten Acre Field of Variable Slope.

larger on light soils. The amount of such fall should be sufficient to equal the depth of water absorbed by the part of the check near the entry, while the check is being filled. For small checks on medium or heavy soils, this may be less than the natural variations in surfacing. In such cases care should be taken to get the back end of the check at least as low as the near end, without giving any decided fall.

Level checks may be preferable for either very heavy or very light soils. On heavy soils it may be necessary to pond the water on the land, in order to get a sufficient depth of absorption. This can be done most easily and uniformly with level checks. On very light soils, washing may occur on sloping checks. This is not to be expected, however, with irrigating heads, as small as those under discussion here. The chief use of level checks, except in very heavy soils, is for those conditions where long, narrow, sloping checks cannot be arranged without excessive grading. It may be necessary in some fields to use a few level checks in irregular portions, strip checks being adjusted to the remainder.

Contour Checks.

Contour checks are essentially the same as the level checks previously discussed, except that they are irregular in shape instead of rectangular. Where the contours are straight and parallel, contour checks become rectangular checks. The use of contour checks was formerly more general than at present and few, particularly for small checks, are now built. The contour check has the advantage of being fitted more closely to the original ground surface and of requiring less grading; for small checks this difference is not material. They have the disadvantage of being irregular in shape, requiring irregular ditch locations and adding to the inconvenience in handling the crop. In rough fields, a few contour checks may be used in certain portions to reduce the cost of preparation; they are not now considered desirable for fields as a whole.

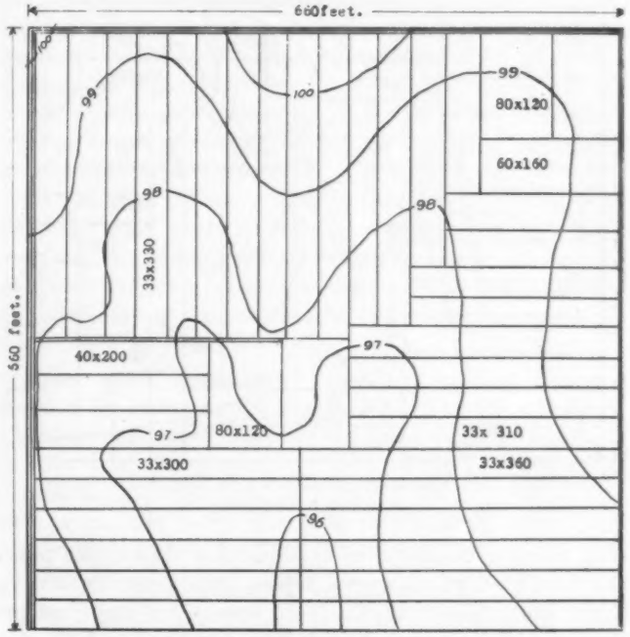

Fig. 4. Combination Strip and Rectangular Checks on Ten Acre Field of Irregular Topography.

Examples of Check Design.

Arrangements of checks for various conditions are shown in Figs. 1 to 5. These are based on the topography before levelling, as shown by the contours. Checks for any field should be arranged so as to reduce the amount of grading to a minimum and also so as to avoid cutting the fields into small or irregularly shaped areas, by the ditches. The latter point is of particular importance where several cuttings of alfalfa are secured per year; it might not be of moment for a single crop, such as grain. The levees can be crossed in moving; ditches cannot. The size and slope of the checks are determined by the considerations previously discussed.

In Fig. 1, a field having a uniform slope in two directions is shown. For the light soil and small head shown, the checks are run down the steeper slope, about 1 in 100. For checks running down the flatter slope, about 4 in. per 100 ft. could be used and would

be preferable for heavier soils or for larger heads. For larger heads, the checks could be made wider, such as 40 ft., if a supply of 1½ or 2 second feet were available. For heavier soils, the checks might be 660 ft. long, thus avoiding the ditch through the center of the field.

In Figs. 2a and 2b, the same field is laid out for strip and level checks. Although the direction of the slope changes, the field can be adapted to strip checks, as shown in Fig. 2a. The rectangular checks in Fig. 2b are planned to give as little levelling as practical. For the 10 acres in this field, the strip checks shown require 1320 ft. of field ditch; the rectangular checks, 2260 ft. The field would be cut in three pieces if in

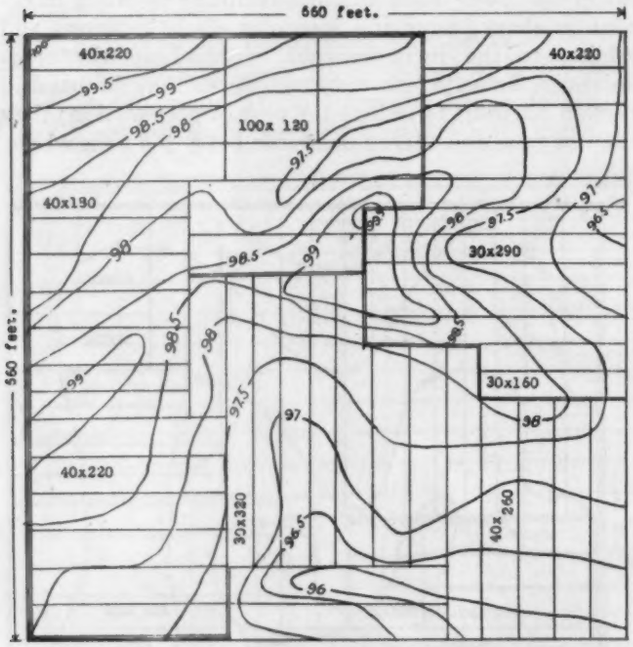

Fig. 5. Arrangement of Checks on Ten Acre Field of Uneven Surface.

strip checks; in five, if in level checks. If surface pipes are used instead of open ditches, this objection can be overcome. About 12,000 ft. of levees are required for the strips as compared with 5000 for the level checks. These comparisons show the advantages of the strip checks for land of this character. The strip checks usually have a slope of about 4 in. per 100 ft., and are made 33 ft. wide. A few checks have as small a slope as 1½ in. per 100 ft. This could be increased by grading. The checks indicated would be suited to heads of 2 second feet on medium or light soils, or to 1 second foot on heavy soils. For heavy soils, the checks might be run across the whole field where the slope permits, as on the upper half.

In Fig. 2b, the checks have an area of about 0.3 acre. The amount of levee is smaller than for the strip checks, but the grading necessary to level the checks would be greater. The slope of the land is not large, and this field would be relatively inexpensive to prepare by either method.

Figs. 3 and 4 illustrate fields having slopes irregular in both amount and direction. These are planned for strip checks where feasible with rectangular level checks in the more irregular portions. For such fields, a number of arrangements are usually possible. If the slope were smaller, such as half of those shown, rectangular checks for the whole field might be preferable. In Fig. 3 the strips are made 40 ft. wide in the flatter portions; a head of 2 second feet would be desirable for these. In the steeper portions this might be decreased to 30 ft., and 2 checks run at the same time. The length of the checks is limited by the topography. If only one second foot could be secured, the flatter checks should be made 20 to 34 ft. wide.

In Fig. 5 an arrangement of checks for a very uneven piece of land is shown. For such land, a topographic survey is practically necessary, if the checks are to be planned to advantage. The checks shown are planned to give the minimum amount of grading. Some additional levelling would avoid some of the irregularities, and would be desirable, such as to carry the main checks through to the lower end in the center and avoid the two checks shown. The knoll would require to be levelled to elevation 99 or lower, the earth going into the low strip above it. The supply ditch would have to be held in a light fill to reach it. The use of surface pipe to supply the checks would be of advantage if the water is secured by pumping.

On these sketches open ditches are shown. Surface pipe connected in the field for each irrigation could be used. The mowing and handling of the crop is much easier with such pipe. For permanent development concrete pipe with hydrants for each check could be used.

PROSPECTIVE POWER MARKET FOR IRRIGATION PUMPING IN OREGON AND WASHINGTON.

BY JOSEPH JACOBS.

(Concluded.)

In reviewing the tabulation in Fig. 40 one will no doubt be struck by the apparent high annual cost of maintenance and operation, which is of course an important element of any irrigation project. These costs are in fact somewhat high, due to the high pumpage lifts involved but also it may be said that they appear high because we are as yet not accustomed to them in this northwest territory although they are not uncommon to other localities as for instance in California, in Porto Rico and in Hawaii, where no more valuable crops are grown than is possible to the lands herein considered.

I regard all the projects listed in the tabulation as ultimately feasible upon the lines outlined in the foregoing pages of this report, but before closing I would again advert to the fact that many cheaper gravity projects must precede them in order of development and that the larger projects will depend for their success upon some generous scheme of finance and credit founded upon co-operative state and federal aid working perhaps through local irrigation districts.

This entire question of the amount of agricultural development and of general industrial development as well, that might be brought about by the availability of cheap electric power, is of such transcendent importance to the states of Oregon and Washington as to justify its continued study on the part of the proper bureaus and public-spirited citizens and to call for the most careful consideration on the part of the legisla-

tive branches of our state and federal governments until the ends desired are finally attained.

Typical Analysis of Irrigation Pumping Problem.

Permissible lift for a 10,000 acre project devoted entirely to fruit culture and subdivided into 20 acre farm units.

It is here assumed that actual occupancy of the ranch by the owner does not begin until the sixth year, at which time the orchard begins to bear, and the owner erects his farm buildings and secures his stock and equipment. During the initial five years it is assumed that the place is cared for by hire.

Initial Investment—		
Land and water rights including proportionate ownership of all irrigation works at $100 per acre	$2,000	
Fencing	200	
Clearing, leveling and farm laterals	500	
Plowing and planting to orchard	500	$ 3,200
Investment at end of Fifth Year—		
Initial investment as above	$3,200	
Iuterest 6 per cent, taxes 1 per cent, = 7 per cent compounded annually for 5 years	1,300	
Depreciation of fencing, 5 years at 6 per cent.	60	
Cost of labor and material and pumping, less temporary crops, for 5 years, including interest and taxes compounded annually, say	3,840	
Farm buildings exclusive of fencing	1,000	
Farm equipment (buggy, wagon and implements)	300	
Farm stock (team, one cow, chickens, etc.)	300	$10,000
Annual cost after owner is living on place—		
Interest 6 per cent, taxes 1 per cent = 7 per cent on $10,000	700	
Depreciation of farm building and fences at 6 per cent	72	
Depreciation of farm equipment at 72 per cent	48	
Depreciation of stock at 8 per cent	24	
Fertilizer at 50c per acre	10	
Material for spraying and other treatments at $10 per acre	200	
Extra labor and material for picking, packing and hauling fruit to warehouse at 37½c per box = $75 per acre	1,500	
Allowance to rancher for his own labor	720	
Total exclusive of pumpage and canal maintenance	$3,274	
Crop returns—		
Average crop yield of 200 boxes of apples and pears per acre, with a net return to grower, after commissions and freight have been deducted, of 90c per box = $180 per acre	$3,600	
		Per Acre.
Available for pumpage and canal maintenance, $326 =		$16.30
Cost of canal maintenance alone, say		0.65
Available for pumpage		$15.65
Estimated cost of pumpage for 1000 ft. lift exclusive of power		3.48
Available for power		$12.17

Estimated power consumption per acre per season, 3740 kw.-hr.

Cost per kw.-hr. = $0.00326, which is practically the rate at which Celilo power can be delivered.

The returns from the fruit acreage on the Sunnyside Project in Washington, embracing as it does a considerable area of young orchard, amounted to $219 per acre in 1912 and approximately that in 1913. Under the very abnormal conditions which exist this year, due chiefly to the European war, it will probably be less.

The action of waves on dam faces may cause much damage. On the Deer Flat reservoir of the Boise project it has been necessary to place gravel on the upper face. This was done after the completion of the dam by dumping large amounts of gravel at the top of the slope and letting it work down under the action of the water. The face was originally constructed on a slope of 3 to 1. On the Belle Fouche reservoir it was found that under heavy wave action the water which got behind the slabs of concrete paving could not get our sufficiently quickly when the waves receded. The pressure of this water caused the slabs, which were 5x6½ ft. and 8 in. thick, to move outward. This has been overcome by keying the slabs together.

ACTIVITIES OF SAN FRANCISCO ELECTRICAL CONTRACTORS.

BY C. F. BUTTE.

(This record of experience in conducting a successful local organization of electrical contractors and dealers should be suggestive of what may be done by others and of what yet remains to be done. It constitutes the report of the president of the local association to the California Association of Electrical Contractors and Dealers at their convention at Stockton, July 14, 15, 16, 1916.—The Editor.)

Before outlining any of the work that the San Francisco local has undertaken I want to emphasize the fact that no matter what has been discussed in our local, no matter what action has been taken and no matter what details I may enter into in making this report, all of our work has been along educational lines, along the lines that each member can benefit the other by his experiences, along the lines that each individual member must act in accordance with his best personal judgment, and that at no times do we countenance any combination to force others to act in accordance with such combination. I want it thoroughly understood by all present that the San Francisco local will not, has not, and cannot at any time agree upon, fix upon or determine any fixed price, charge or billing on any materials, work or labor and wherever I have referred to such matter in this report we have always considered and discussed such matters from the educational point of view and the experience of others in the proper guidance and handling of our business, all to be taken by the individual as he may see fit and applied as his own judgment may decide.

The work of the San Francisco local is entirely handled by committees appointed for each respective subject. Whatever success we may have attained is entirely due the respective committees and assisting members. At the present time we have several important matters under discussion that materially effect the industry and to which I shall refer later.

Legislative Committee.

The many questions that continually arise with the enforcement and application of our city ordinances and the many points that need to be clarified are all handled by our legislative committee consisting of Messrs. Hope, Porter and Smith.

This committee recently assisted in the revision and adoption of several important amendments to our present ordinances, in particular the question of switches in rooms with running water. Through their efforts and assistance in this matter switches are now required in all rooms with running water whether the fixture is in reach of the faucet or not, thus simplifying this previous contentious question.

This committee has also had a number of conferences on the question of local licenses. Mr. Hope has made an extensive report covering the number of firms and persons registered in the department of electricity, the cost of running the department for the year, and the possible amount from licenses that would be required to operate the department without additional inspection fees. As a result of this report a $200 flat license per year was recommended.

The question of the use of flexible armored cable in lieu of conduit in construction work has been thoroughly taken up by this committee and after their report it was decided that flexible armored conductor shall be used only in remodeling work and not in new construction, or the use of this material shall be only allowed where the use of rigid conduit is impracticable. To further clarify the questions that are brought up to the department of electricity this committee in conjunction with Chief Barry and the standardization committee has compiled certain data directly effecting the installation work.

This committee now has under consideration the extent and limitation of the use of lead covered conductors in underground and under basement floor conduits.

Labor Committee.

This committee consisting of Messrs. Sittman, De Lew and Butte handles the matter of social insurance. While it may not appear important to the employer at this time, this question of social insurance is a factor that will have to be dealt with and as the industry must carry the burden it is well to fully acquaint ourselves therewith:

As generally defined, social insurance in addition to insuring the wage-earner against the loss resulting from industrial accident, gives him similar insurance against the disastrous results of sickness, invalidity, old age, unemployment and even death.

In this matter the state of California has taken the lead in the United States by establishing a Social Insurance Commission. This commission is required to make a study of the social insurance theory, to examine the European experiments with that theory, and to make a careful survey of the local conditions in the state of California with the end in view of reporting to the legislature as to the advisability of the state widening its activities in the field of social insurance which it has already initiated in its Workmen's Compensation Act.

Practically every European country has a sickness insurance system. Two distinct types have evolved: The voluntary subsidized scheme of Denmark, Sweden and Belgium and the compulsory system shown in its best developed form in Germany and England and found also in Austria, Hungary, Luxembourg, Russia, Roumania, Norway and Servia.

Germany compels the insurance of all wage workers and other employes whose earnings are below a certain level. When the difference in cost and standard of living in the two countries is taken into consideration, this level corresponds to an American income of $1,200 a year.

The premiums for this insurance are paid two-thirds by the employe and one-third by the employer.

England also requires the insurance of all manual laborers and such other employes as earn less than £160 per annum.

The premiums are contributed to by the employe, employer and state in proportions of 4-9, 3-9 and 2-9, respectively. The German method of collecting from the employer, who reimburses himself for the employe's share by holding back part of the wages, has been followed in England.

The necessary premiums for a sickness insurance system in this country providing money benefits of two-thirds the wages during the period of disability, not to exceed 26 weeks in a year, similar benefits from 8 to 12 weeks in maternity cases, funeral benefits of about $100 and medical and surgical benefits including the necessary drugs and hospital treatment, and allowing 10 per cent for administrative expenses, would total a little over 4 per cent of the wages.

Retail Committee.

It is with considerable pride that we can point to a live retail committee consisting of Messrs. Levy, Haverkamp, Keuhn and Scobey.

The latest activities of this committee cover a field pertinent to the future of the retail business. Through their efforts the retailers have under contemplation a publicity campaign to establish in the minds of the public that an exclusive retail electrical store is the proper place to purchase electrical materials and the proper place to obtain satisfactory service. Through individual subscription and whatever assistance the local can give, an advertising campaign will be started to induce the public to deal in an electrical store when purchasing electrical appliances and apparatus and not go to a drug store or similar places.

Uniform window dressing and displays have received considerable thought of this committee and to further the work, one evening each week a meeting is held in one of the retail stores. The work of this committee is entirely educational and to create confidence between all retail dealers. The activities of this committee have resulted in mutual assistance and the various retailers have reached the point where they do not refrain from telling any of their experiences in selling, buying, store methods and costs and at the meeting they now freely express their personal opinions on such matters.

Bidding Committee.

This committee, consisting of Messrs. Fortini, Newbery and Kohlwey, is at all times anxious to present at our meetings correct methods of figuring work, correct methods of presenting bids and correct ways of doing business.

Guarantee Committee.

Our latest undertaking is covered by this heading, namely guaranteeing the work of our fellow member by the collective interests thereby creating an incentive to the owner and architect to award the contracts to our membership. Mr. De Lew is now working on a tentative plan whereby all contracts in legal form taken by any member of the San Francisco local will be guaranteed and vouched for by the entire collective membership of this local. Not only will the completion of the contract be guaranteed but the quality and conforming to the specifications and plans as well. Also any disputes that may arise will be settled by the membership.

Harmony, confidence and good will between the owner or architect and the electrical contractor is the aim of this committee, thereby creating a desire on the part of the former to award the work to the progressive contractor.

Ethics Committee.

This committee, consisting of Messrs. Fortini, Levy and Reid, is now formulating a code of ethics covering the relationship between contractor and contractor, and his dealings with the customer. Much will be done by this committee to create further confidence and harmony between members and their customers and with the work of the guarantee committee we hope that the day will soon arrive when an owner or architect will embody in the specifications and requirements that all bidders must be in a position to qualify under the guarantee and ethic conditions.

HOW— GENERAL FACTS, FIGURES AND THEORY OF CURRENT INTEREST

HOW AUTOMOBILE COSTS ARE KEPT.

For the past several years, the Pacific Power & Light Company has kept an accurate statement as to the expense of its automobiles, and in February, 1915, there was printed in the Bulletin an analysis of these figures for the last half of the year 1914. We are presenting herewith a similar statement for the year 1915.

The theory that an automobile is a cheap means of transportation is not well founded. It is apparent from an examination of the statistics that in no case is automobile transportation for one man as cheap as railroad transportation and in many cases it is ten times as expensive. Of course, in considering this question, attention must be given to the matter of convenience and other important factors. As the number in the car increases, the cost by automobile is less.

Automobile Data for 1915.

Branch.	Make.	H.P.	Miles Run.	Average Miles per Day.	Gal. Gasoline.	Miles per Gal. Gas.	Qts. Oil.	Miles per Quart Oil.
Walla Walla.....	Ford	20	11,647	32.0	755	15.4	167	69.7
Sunnyside	Ford	20	14,495	39.7	900	16.1	288	50.1
Toppenish	Ford	20	9,288	25.5	540	17.2	206	45.0
Pasco	Ford	20	5,814	16.0	423	13.8	90	64.8
North Yakima...	Ford	20	10,670	29.3	700	15.3	77	139.0
North Yakima...	Gen.V.	2T	2,354	6.5	Elec.	*.51	Grease	....
Hood River.....	Loco.	32	5,472	15.0	992	5.5	275	19.9
Naches	Loco.	32	6,366	17.4	771	8.3	100	63.7
Walla Walla.....	Loco.	32	7,500	20.5	743	10.1	147	51.0
Astoria	Chev.	24	6,565	18.0	502	13.1	46	143.0
Irrigation.....	Ford	20	8,938	31.4	459	19.5	98	91.2
Dayton	Ford	20	13,362	43.8	827	14.9	124	99.5
North Yakima....	Over.	35	6,903	31.7	528	13.1	76	91.0
Vancouver	Cadl.	30	2,852	13.3	328	8.7	32	89.3
Prosser	Ford	20	1,600	20.2	136	11.8	15	107.0
Total			112,826	23.9	8604	†12.8	1741	†63.3

*Per kw.-hr. †Not including Electric Truck.

All the cars mentioned in tables operated for a full year, with the exception of the last five. The irrigation Ford operated for 284 days, the Dayton Ford operated for 282 days, the North Yakima Overland 218 days, the Vancouver Cadillac 214 days and the Prosser Ford 79 days. All other cars are charged with a full 365 days. In working up averages and other details, the actual number of days operated for the short-term cars has been taken into consideration.

Automobile Data for 1915.

Branch.	Make.	Cost Gasoline.	Cost Oil.	Repairs Engine and Body.	Tires and Tubes.	Garage.	Misc.
Walla Walla...	Ford	$137.96	$32.90	$97.51	$197.85	.....	$28.80
Sunnyside	Ford	153.31	42.24	168.50	251.20	$40.00	136.50
Toppenish	Ford	83.48	19.91	157.77	100.14	.....	31.65
Pasco	Ford	65.19	18.20	116.95	86.20	.....	17.55
North Yakima.	Ford	106.43	9.19	109.71	113.30	12.50	22.20
North Yakima.	Gen.V.	*322.63	8.10	70.41	88.95	.....	12.35
Hood River....	Loco.	160.97	53.97	706.38	153.85	25.00	45.35
Naches	Loco.	114.73	12.48	164.82	221.21	.....	48.37
Walla Walla...	Loco.	132.30	18.60	250.66	170.74	16.60	48.54
Astoria	Chev.	63.34	7.48	210.94	140.85	38.00	9.10
Irrigation	Ford	73.56	15.88	34.51	69.80	4.60	12.53
Dayton	Ford	151.27	21.10	67.03	114.35	14.95	34.78
North Yakima.	Over.	83.79	10.24	20.03	110.85	.....	42.86
Vancouver	Cadl.	37.56	5.25	16.75	34.22	15.00	8.45
Prosser	Ford	27.23	1.75	.....	3.75	6.25	10.25
Total		$1713.75	$277.29	$2193.97	$1857.26	$172.90	$509.28

*Cost of energy for storage batteries at 7c per kw.-hr.

The energy used for the electric truck at North Yakima was charged at the rate of seven cents per kilowatt-hour. This is direct current energy and it is believed that would be an average price that a private consumer would have to pay for it if he bought it from a public service company. All other details in the table are presumed to be self-explanatory. The difference between the operating cost per mile and the total cost per mile is purely a question of depreciation, which is figured at 2 per cent a month on the original value of the car.

Branch.	Make.	Insurance.	Depreciation.	Total Expenses.	Operating Cost per Mile Cents.	Total Cost per Mile Cents.	Cost per gal. Gasoline. Cents.
Walla Walla....	Ford	$45.35	$146.40	$ 686.77	4.63	5.93	18.3
Sunnyside	Ford	38.25	158.40	988.40	6.67	7.77	17.0
Toppenish	Ford	38.25	152.40	583.60	4.65	6.3	15.5
Pasco	Ford	39.75	156.00	499.84	5.88	8.55	15.5
North Yakima..	Ford	36.75	153.60	563.68	3.85	5.27	15.3
North Yakima..	Gen.V.	86.50	960.00	1,548.94	25.00	65.7	*7.0
Hood River.....	Loco.	93.00	480.00	1,718.52	22.6	31.4	16.2
Naches	Loco.	93.00	480.00	1,136.61	10.3	17.8	15.0
Walla Walla....	Loco.	93.00	480.00	1,210,44	9.73	16.6	17.8
Astoria	Chev.	47.50	228.00	745.21	7.96	11.3	12.4
Irrigation	Ford	34.45	107.30	352.63	2.74	3.93	16.0
Dayton	Ford	34.20	101.20	538.88	3.54	4.35	18.3
North Yakima..	Over.	35.85	128.40	432.02	4.4	6.25	15.8
Vancouver	Cadl.	50.89	210.00	378.12	5.9	13.3	11.4
Prosser	Ford	9.56	26.26	85.05	3.7	5.3	20.0
Total		$776.30	$3967.96	$11,468.71	6.65	10.2	†16.1

* Per kw.-hr. † Not including electricity.

FACTS AND FIGURES OF CURRENT INTEREST

The Nippon Yusen Kaisha, controlling a fleet of ships that called at certain Pacific Coast ports, during last year netted in profits $5,259,303.

* * *

During the past ten years the registration of automobiles in various states has increased 5000 per cent, or from 48,000 in 1906 to 2,445,664 in 1915.

* * *

The Bureau of Census reports that in 1914 returns were received from 1284 establishments engaged in the gas industry and that their total products for the year were valued at $220,237,781.

* * *

California has more automobiles in proportion to population than any other state in the union. In actual number this state ranks fourth with her 163,795 registrations in 1915 as opposed to Illinois, Ohio and New York with 180,832, 181,332, 231,831 respectively.

* * *

The ancients may have been correct in poetry and song concerning the great continent of Atlantis. Says an authority of the French Academy of Sciences: "No affirmation is yet permissible, but it seems more and more evident that a vast region, continental or made up of great islands, has collapsed west of the Pillars of Hercules, otherwise called the Strait of Gibraltar, and that its collapse occurred in the not far distant past. In any event, the question of Atlantis is placed anew before men of science."

* * *

California Good Roads enthusiasts are urging the setting aside of a "Good Roads" day during the Fall for the consideration and inspection of the system of beautiful state highways already completed. The work of good roads in California started four years ago with a bond issue of $18,000,000, of which all but about $2,000,000 has been expended. The last legislature voted an additional bond issue of $15,000,000. The final vote of approval on the part of the citizens of the state is set for the November election.

JOURNAL OF ELECTRICITY
POWER AND GAS

FOUNDED 1887

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Crossley Building, San Francisco

ON LIBRARY CARS OF ALL SOUTHERN PACIFIC TRAINS

TERMS OF SUBSCRIPTION.

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each,	.25

NOTICE TO ADVERTISERS.

Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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A Bridge of Mammoth Proportions

The proposition to link the cities of Berkeley, Alameda, Oakland and San Francisco by a gigantic bridge has long been a matter of speculation and sincere yearning on the part of the thousands of commuters who daily travel back and forth between these sister cities. While the proposed bridge structure represents as a whole a magnitude of bridge engineering hitherto unattempted in constructive effort, still upon close analysis it is found that no unusual or untried features need be undertaken in its accomplishment. And best of all the data that are being gathered by the various civic bodies engaged in investigating the proposition goes to show that in spite of an estimated cost of twenty-two million dollars, the project will be a paying one from the start. The forty million passengers that annually cross on the ferry boats coupled with the enormous railroad and vehicle traffic make the proposition one that will undoubtedly pay for itself in from fifteen to twenty years.

While the San Francisco-Oakland bridge in some respects may be characterized as merely of local interest, yet from its broader aspects the entire West is vitally interested. A mammoth bridge uniting two growing communities will do far more than link together a people now numbering nearly a million by a physical structure of steel and concrete, but indeed it will serve as a link in binding the interests of all into one indissoluble unit.

The resultant good effect that is derived from the inter-linking of communities has long since been felt throughout the West due to the great hydroelectric networks that now thread its fertile valleys. The eight minute service to Oakland and the fifteen minute service to Berkeley are attractive features beyond measure, but the West congratulates the bay cities not so much upon these possible realizations from the bridge proposition as upon the impetus that is bound to result for still further forwarding the get-to-gether spirit throughout our Western communities.

The Water Power Error

When you read that "the public's last great natural resource is being stolen by private spoilers, and enormously valuable water powers are being given away to power grabbers," you naturally wonder whether it may not all be so. You are doubtful and curious as to the truth in this insinuation and accusations that spring up like mushrooms in the editorial muck rooms. You are inclined to believe that the cited Forest Service reports showing monopoly and over development of water power in the Western states are correct.

Yet before passing final judgment is it not well to remember that this question, like all others, has two sides? The one which appeals to public passion and creates public prejudice has been given wide publicity; largely because it comes from supposedly disinterested sources. The other, based on common sense and reason, is seldom given due consideration, as it may be set forth by interested parties.

In matters of public welfare such as this reason should carry more weight than passion. Government reports and investigations are often made for purely

political purposes and in this respect the Forest Service report on water powers is no exception. Its avowed purpose was to discover the existence of monopoly and by inference to suggest its evil. By a mass of irrelevant data it bolstered up proof of what no one denied, —strongly centralized control of power development,— but ignores the fact that there is an economic necessity and benefit.

Analyzing this editorial's opening quotation which is a composite of statements made in the August number of a monthly magazine of national circulation, what are the facts? Are enormously valuable water powers being stolen by private spoilers?

Water idly tumbling from the heights is useless until harnessed. A power site, undeveloped is valueless. The use comes from the harnessing, the value from the development. Without capital for this development the water powers have no present value. Great financial risk is involved in this development and even under the most favorable conditions capital is chary of capture during the long term before a hydroelectric transmission system becomes profitable.

Before governmental restriction was placed on water power development the probable returns were sufficient to induce investment in projects which even yet have paid no dividends. The difficulties under which these most favored propositions have labored would have deterred investment in similar ones. With the added federal probabilities and the drastic action of regulating commissions, moneyed men simply refused to take the risk.

Water power developers are not private spoilers. Usually they have created the market to which their power is sold. They have established new industries, they have colonized tracts, and in this way contributed far more to the general prosperity and advancement of communities than to their own wealth.

A people's progress is measured by the amount of mechanical power utilized. The complex structure of modern civilization would collapse without the energy of steam, water and electricity. So, whatever influences the production of energy changes the state of civilization. Two great sources of energy are fuel and water. Fuel, once consumed, is slowly replaced. Water power renews itself continuously and indefinitely. The present consumption of coal and oil for power production frequently represents an enormous waste of energy that should be consumed for future needs.

With water power the conservation is the reverse of the case with fuel. With fuel non-use is conservation, with water full use is conservation. Coal miners may be spoilers, but water power developers are the highest type of conservers. Every kilowatt-year of hydroelectric energy utilized represents an actual saving of more than one long ton of coal burned under the most efficient conditions of modern steam power plant practice. Henry G. Stott of New York City, past president of the American Institute of Electrical Engineers and a recognized authority on steam power, has stated that the hydroelectric power generated in this country represents a saving to posterity of twenty million tons of coal annually. Then should not the water power developer be encouraged in every way possible?

The fundamental mistake in handling the water power situation has been the failure to make this distinction between the conservation of fuel and of water. This mistake was founded in ignorance, but persists in error, ignorance being the not knowing of things, error the knowing of them falsely.

Cost of Autos for Utility Companies

It has long been a matter of speculation as to the actual costs met with in public utility maintenance and operation in its automobile account. On another page of this issue may be found a detailed statement of costs in operation and upkeep of fifteen automobiles owned by the Pacific Power & Light Company during 1915. The total mileage of these cars was 112,826 and the total expenditures including insurance and depreciation $11,468.71 which represents an average cost per mile of 10.2 cents. If consideration of the electric truck be neglected in the above figures, the passenger automobiles actually travelled 110,472 miles at a total cost of $9919.77, averaging about nine cents per mile.

This compilation of data emphasizes two important features. In the first place in no case does an automobile with single passenger cover its distance as cheaply as can be done by modern railroad transportation. And in the second instance if a reasonable wage for the driver is to be added, as in the case of jitney transportation, it shows that the automobile still must struggle for increased efficiencies and lower costs of operation except in most favored instances in order to economically displace the modern steam railroad systems or the electric train for passenger traffic.

As to the mobility and freedom of action in the case of the automobile when compared with any other known source of transportation the former must be given the unquestioned supremacy. That the horse is now being practically displaced in rural communities for passenger transportation and indeed for all farm duties can no longer be denied.

It must be admitted too, that the transportation situation is at present in a state of flux. In the rural communities the automobile and tractor are not only displacing the horse for farm conveyance in general but in many communities the passenger and freight traffic of long established steam and electric lines are beginning to feel the effects of this new trend of modern evolution in transportation.

The future alone can, however, determine the much mooted question of the economic advantage of transportation by automobile as compared with the steam roads or with electric traction.

PERSONALS

C. G. A. Baker, vice-president and treasurer Baker-Joslyn Company, is at Seattle.

A. Morbio, electric truck specialist with Great Western Power Company, is at San Diego.

J. M. Chamberlain, salesman Fobes Supply Company, has returned to Portland from San Francisco.

Jos. Sachs, inventor of the "Noark" fuse, expects to be at San Francisco August 17th from Hartford, Conn.

G. Douglas Jones, electrical engineer California State engineer's office, was at San Francisco this week.

L. J. Moore, load dispatcher San Joaquin Light & Power Corporation, is spending his vacation at San Francisco.

G. R. Wright, sales agent with the Canadian General Electric Company, is at San Francisco from Vancouver, B. C.

F. C. Heoppner, manager Bertram Bros. Electric Company, has returned to Phoenix, Ariz., from Los Angeles.

W. L. Goodwin, vice-president, in charge of sales Pacific States Electric Company, motored to Lake Tahoe this week.

W. R. Pigg, of Berkeley, Cal., has been elected vice-president and treasurer of the Central California Gas Company.

E. A. Weymouth, assistant manager Pacific Gas & Electric Company at Sacramento, was at San Francisco this week.

A. R. Marvin, salesman with the Pacific States Electric Company at Portland, has been called east by the death of his father.

E. A. Quinn, general superintendent San Joaquin Light & Power Corporation, has returned to Fresno from San Francisco.

D. E. Harris, sales manager San Francisco office Pacific States Electric Company, has returned from a two months' trip East.

Geo. Bernhard, assistant manager Great Western Power Company at Sacramento, has returned from a visit to San Francisco.

Fred Hamilton, superintendent Western division Mt. Whitney Power & Electric Company, was at San Francisco this week from Visalia.

H. A. Case, salesman with San Francisco office Western Electric Company, has returned from a two weeks' vacation at Willitts, Cal.

J. R. Baker, general auditor of the lamp works of the General Electric Company, was at San Francisco during the past week on business.

W. G. Stearns, sales agent with San Francisco office Standard Underground Cable Company, has returned from two weeks at Santa Rosa.

Ross Hartley, manager Portland office Pacific States Electric Company, is spending several weeks on a vacation trip in the mountains of Oregon.

S. P. Russell, manager electrical department H. W. Johns-Manville Company at San Francisco, is making an automobile tour to Crater Lake, Oregon.

M. S. Orrick, Western Electric Company, San Francisco, expects to leave this week for Yosemite Valley and Lake Tahoe via the newly-opened Tioga road.

L. A. Nott, assistant manager San Francisco office Standard Underground Cable Company, has returned from a three weeks' business and pleasure trip through the Sierras.

F. D. Fagan, manager Edison Lamp Works at San Francisco, and **M. H. Schnapp**, meter specialist General Electric Company, are making an automobile trip to Yosemite Valley.

J. B. Rowray, superintendent of the Northern Electric Railway Company at Chico, has been appointed to the office of general manager made vacant by the death of William McGovern.

R. E. Fisher, commercial department Pacific Gas & Electric Company, has returned to San Francisco from the mines of Nevada county.

J. C. Stone, assistant traffic manager for the Northern Electric Company, was married on the evening of July 14th. Mr. and Mrs. Stone, having spent their honeymoon at Princeton-by-the-Sea, are now back at Sacramento.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The commission has issued an order approving a trust deed by the Martinez & Concord Interurban Railway Company to secure an issue of $200,000 of first mortgage six per cent 25 year bonds.

The commission has issued a supplemental order authorizing the Inglewood Water Company to sell $13,000 face value six per cent first mortgage bonds at 95 per cent, to refund indebtedness.

The commission has authorized the Nevada-California-Oregon Telephone & Telegraph Company to issue $15,000 face value six per cent bonds at not less than 80 per cent.

The commission has authorized the Visalia Electric Railroad Company to issue 460 shares of its common stock, par value of $100 a share, to the Southern Pacific Company.

The commission has authorized W. F. Boardman, Charles F. Leege and William C. Crittenden to sell to Newport Beach their gas distributing system for $1773, certain real estate for $3000 and to lease property at $250 a month pending sale.

The Santa Paula Water Company has applied to the commission for authority to issue promissory notes for not more than $10,000 for from one to five years at not more than 7 per cent.

The Economic Gas Company of Los Angeles has applied to the commission for an extension of time until June 30, 1917, to sell $262,000 of its five per cent bonds.

The Irwin Heights Water Company has filed with the commission an application for authority to sell its water system to the city of Santa Monica for $75,000.

The commission has issued a supplemental order authorizing the Economic Gas Company to issue $262,000 face value 5 per cent bonds to be sold for corporate purposes. The bonds are to bring not less than 83 1-3 face value.

TRADE NOTES.

H. B. Squires Company of San Francisco have been reappointed Pacific Coast agents for Matthias Klein & Sons of Chicago.

The San Francisco offices of Allis-Chalmers Manufacturing Company have been removed from the southwest corner of New Montgomery and Mission streets to suite 741-751, Rialto building.

Benjamin Electric & Manufacturing Company are handling the sale of Dimalites for the Wirt Company of Germantown, Pa. F. H. Poss, Pacific Coast manager, has a large stock at San Francisco and advises that an extensive advertising campaign is planned.

The Lyman Electric Company have recently opened a new fixture and repair shop at 106 North California street, Stockton. The new place has been fitted up like a beautiful reception room, making a cozy appearance and no doubt will prove most attractive to the women purchasers of lighting fixtures and appliances.

The capital stock of the Morse Chain Company of Ithaca, New York, has lately been increased from $400,000 to $1,500,000 for expansive purposes in the shape of new buildings and additions to old ones already under way. Present plans contemplate again doubling the size of the plant, a large storage building being about completed, additions to the steel and wire mills and a new gas producer building being well under way, and another large addition to the main building, increasing its total length to more than 900 ft., soon to be started.

RECENT TESTS ON STEEL BEAMS AND GIRDERS.

The engineering experiment station of the University of Illinois, in Bulletin No. 86, has recently set forth new test data on structural strength of I-beams and girders that adds new light in design, especially in considering stresses that cause buckling of girders as opposed to straight failure due to crushing.

DETERMINATION OF CONTRACTORS' OVERHEAD.

The Electrical Contractors' and Dealers' Association of San Francisco have appointed a committee to obtain the actual overhead costs of doing business of each member. Upon completion of this report an average will be taken, and every member will then know what per cent he should add to the cost of his labor and material before his percentage of profit is added. This report will appear later.

CIVIL SERVICE EXAMINATION.

The United States Civil Service Commission announces an open competitive examination for electrical draftsman, for men only. From the register of eligibles resulting from this examination certification will be made to fill several vacancies in this position in the New York Navy Yard at salaries ranging from $3.52 to $6 per diem, and vacancies as they may occur in positions requiring similar qualifications, at any navy yard or other naval establishment of the United States or in the Department at Washington, unless it is found to be in the interest of the service to fill any vacancy by reinstatement, transfer or promotion.

BOOK REVIEWS.

Ozone, Its Manufacture, Properties and Uses. By A. Vosmaer, Ph. D.; 197 pp.; 6x9 in.; 70 illustrations. Published by D. Van Nostrand Company, New York, and for sale by Technical Book Shop, San Francisco. Price $2.50.

The subject of ozone is one of great variety; it involves chemistry, physics, bacteriology, hygiene, industrial chemistry, electrical and mechanical engineering. The treatment of this important subject as set forth in this book is covered under three main headings: The nature of ozone, the manufacture of ozone, and the uses of ozone. In the main, the work details the author's experience as a chemical and electrical engineer covering some fifteen years' experience in investigations and practical applications of ozone.

The book will serve as an excellent guide for those interested in the subject matter treated.

Electric Wiring Diagrams and Switchboards. By Newton Harrison, E. E., with additions by Thomas Poppe; 303 pp.; 5x8 in.; 130 illustrations. Published by the Norman W. Henley Company of New York, and for sale by the Technical Book Shop, San Francisco. Price $1.50.

The first edition of this work appeared in 1906. During the ten years that have elapsed the ever increasing use of transformers and measuring instruments has led to the inclusion of these two important subjects in the matter treated. The strong feature of the book is its extremely clear method of presentation. The author inductively leads the reader step by step in such a manner as to wean the wireman away from the use of text books and other references, thus making him able to calculate voltage drops and find the required circular units of wire without a table.

Theory and Calculation of Alternating-Current Phenomena. By Charles Proteus Steinmetz, A. M., Ph. D.; 480 pp.; 6x9 in.; 220 illustrations. Fifth edition; thoroughly revised and entirely reset. Published by McGraw-Hill Book Company, Inc., New York, and for sale by Technical Book Shop, San Francisco. Price $4.00.

The works of Dr. Steinmetz are too well known and too highly valued by the electrical engineering profession to elaborate here on the strong features of this book. Suffice it to say that this present work constitutes the first of three volumes which will represent in a thoroughly revised and entirely reset form the fifth edition of the author's "Alternating-Current Phenomena," which first appeared nearly twenty years ago. In this present volume is included only the discussion of the most common and general phenomena and apparatus, old and new, revised and expanded so as to bring it up to our present knowledge.

In the present edition of "Alternating-Current Phenomena" the crank diagram of vector representation, and the symbolic method based on it, which denotes the inductive reactance by $Z = r + jX$, have been adopted in conformity with the decision of the International Electrical Congress of Turin.

NEW CATALOGUES AND BOOKS RECEIVED.

"The Insulator Book," a publication by the Locke Insulator Manufacturing Company, of New York, has just made its appearance. The book has 184 pages and is replete with illustrations.

Trolley Line Material, including clinch bars, trolley splicers, frogs and suspensions, are described and illustrated in descriptive leaflet No. 3881 just issued by the Westinghouse Electric & Manufacturing Company.

"The Economy Produced by Using Reversing Planer-Motors on Machines Having Reciprocating Motion" is the title of descriptive leaflet (No. 3554-A) just issued by the Westinghouse Electric & Manufacturing Company, in which this subject is thoroughly discussed, illustrations and a summary of machine tool operating expense given.

The publishers of this book are manufacturers and engineers of high voltage insulators and other electric power line specialties. The book gives a compilation of data and specifications for high voltage installations gathered from a wide range of authoritative sources After briefly reviewing the history of high voltage transmission, there follow discussions of mechanical construction, minimum spacings, general specifications for steel towers, poles, wires and cables, details of design, cross-arms, inspection and a horde of other useful information. The illustrations throughout are excellent. For anyone interested in the subject of high voltage transmission, the book should receive a cordial reception on the book shelf reserved for practical reference on standard design and specification.

TRANSMISSION.

BOISE IDAHO.—The substation of the Federal reclamation service was destroyed by fire. Mr. Harris was overseer of the plant.

WOODLAND, CAL.—The board of supervisors has granted the Northern California Power Company a franchise to transmit electric current along the highways of this county.

GRASS VALLEY, CAL.—The Pacific Gas & Electric Company has awarded a contract for the immediate raising of Lake Spaulding dam 35 ft. The contract has been let to Tuohy Brothers.

AUBURN, CAL.—An agreement has been reached between the Placer County Land Company of this city, and the Pacific Gas & Electric Company, giving the latter a right of way across the property of the land company.

CARSON, NEV.—Work has commenced on the new power plant to be built on the Carson River near Gardnerville by the Douglas Mining & Power Company. The survey and preliminary work on the ditch line has been completed and the construction of the mile of ditch has started.

SANTA FE, N. M.—Another step toward furnishing of electric current to Albuquerque, Santa Fe and Las Vegas from the waters of the Rio Grande in White Rock canyon, has been taken. The capital of the company has been increased from $1,000,000 to $3,000,000. Final plans for the dam and power plant have been filed with the state engineer and must be approved before the company can proceed. The initial cost of the project is estimated at $1,933,615.

NEWS NOTES

INCORPORATIONS.

TEMPE, ARIZ.—Darling's Electric Vaporizer Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are L. H. Darling and H. M. Porter, both of Los Angeles. The principal place of business will be Phoenix, with a branch office at Los Angeles, Cal.

ROSWELL, N. M.—Articles of incorporation have been filed by the Lincoln County Light & Power Company of Parsons. The capital is $150,000 and the incorporators are: J. H. Fulmer and Geo. H. Fuller of Chicago; A. T. Graham of South Bend, Ind.; Geo. L. Ulrick of Carrizozo, and A. T. Anderson.

ILLUMINATION.

FORT BIDWELL, CAL.—The Bidwell Electric Company has been granted a franchise to operate an electric light and power system here.

LOS ANGELES, CAL.—The city council has ordered the installation of necessary appliances for lighting Hollywood boulevard between Wilcox and Cherokee avenues.

POMONA, CAL.—Eight cities in Pomona and San Gabriel valleys will be served with natural gas within ten months, according to the plans of the Southern Counties Gas Company.

LOS ANGELES, CAL.—The board of supervisors has granted the request of the Homeward Avenue Lighting District Lighting Committee for furnishing globes through the mechanical department.

BOISE, IDAHO.—The public utilities commission has granted a certificate of public convenience and necessity to the Utah Power & Light Company to furnish electric service to the village of Lava Hot Springs.

HAYWARD, CAL.—A new lighting system of electroliers in place of the present lighting will probably be installed in this city, following an investigation made by the committee appointed by the Chamber of Commerce.

MYRTLE CREEK, ORE.—The city council has ordered notices posted calling for a special election to be held on August 26th to vote on a bond issue of $27,000 for the construction of a municipal electric light system. Plans were submitted by M. B. Germond, engineer for the project.

OAKLAND, CAL.—The Pacific Gas & Electric Company has purchased the southwest corner of Seventeenth and Clay streets, 50x100 ft., for $100,000. The company will build a class A 8 story building, which it hopes to occupy within one year, plans for the structure having already been drawn up.

SEATTLE, WASH.—Superintendent J. D. Ross of the city lighting department, states that two substations will be constructed, one at the present city plant on Stoneway and Fremont and the other at Ballard near Twenty-second avenue and Vernon place. The buildings will cost about $75,000. Plans will be prepared later by Daniel Huntington, city architect.

LOS ANGELES, CAL.—The Economic Gas Company has filed suit against the Southern California Gas Company for damages in the sum of $67,233. The suit is the outgrowth of an alleged contract entered into between the two companies October 26, 1912. Under this purported contract the Southern California Gas Company is alleged to have obligated itself to furnish natural gas to the Economic Company, from April 1, 1913 to September 1, 1932.

IRRIGATION.

TWIN OAKS, CAL.—W. H. Bissell expects to have an irrigation plant in operation shortly which will enable him to pump 10,000 gallons an hour.

WEAVERVILLE, CAL.—Manager Roscoe J. Anderson of the Northern California Counties' Association is making an investigation of the Hayfork Valley, where an irrigation system to water 27,000 acres has been suggested.

LINDSAY, CAL.—The board of directors of the Lindsay-Strathmore Irrigation District will receive bids up to August 14th, for the construction of irrigation works for the district. The work to be done embraces 37 wells and well pumping plants.

SACRAMENTO, CAL.—As a result of a decision handed down by Superior Judge Peter J. Shields in a suit brought by the Capital Banking & Trust Company, as trustee for the bondholders against the American Irrigation Company, the Fair Oaks, Citrus Heights and Carmichael Colony distributing system, owned by the irrigation company, will be sold to the bondholders and undergo extensive improvements. The system will be sold to satisfy a prior claim of the North Fork Ditch Company of $19,700 for water supplied the American Irrigation Company. All in excess of that sum will go to liquidate the bonds.

PLACERVILLE, CAL.—Property owners in the proposed Diamond Ridge Irrigation District in this county, in session here voted to hold meetings in the district for the organization of the property owners therein. The district embraces 85,000 acres, 60,000 acres of which will be irrigated under the results of investigations conducted by engineers for the Diamond Ridge Ditch Company.

BUTTE VALLEY, CAL.—The Butte Valley Land Company, which owns a tract of 25,000 acres in Butte Valley, Plumas county, and has a lease on an adjoining tract of 16,000 acres, is constructing an irrigation system which will water 10,000 acres at a cost of $75,000. The remainder of the tract will be irrigated by wells, many of which are in operation throughout the valley.

IRRIGATION, CAL.—David Blankenhorn, of the Blankenhorn-Hunter Company of Pasadena, was the only bidder for the issue of the $210,000 bonds for the improvement of the Stinson-Burrell Reclamation District No. 1605. According to Trustees L. A. Nares, C. L. Adams and J. R. Erskine of the reclamation district, this is the first time in the history of California that par has been bid for an issue of bonds for reclamation purposes.

LOS ANGELES, CAL.—The first step toward solving the problem of the conservation and utilization of water which goes to waste in the various canyons in Southern California was begun when the Forest Service started a concrete base work for the establishment of a network of water stage recorders. The first of these water measuring devices will be installed in Santa Anita Canyon. Later, water recorders will be put in San Antonio, San Dimas, San Gabriel, Monrovia, Millard, Arroya, Big Tejunga, Pacoima and Big and Little Santa Anita Canyons. According to authorities, water which now goes to waste in these canyons, could be used for irrigation and other work.

SALEM, ORE.—In co-operation with John T. Whistler, or the United States Reclamation Service, John H. Lewis, State Engineer, has just completed the preparation of plans and estimates of cost for the reclamation of 60,000 acres of land in Warner Valley in Lake county, and of 36,000 acres along White River in Wasco county. Under the Warner Valley project, it is proposed to drain a large area of swamp lands in that section so that 33,000 acres can be irrigated by gravity and 27,000 acres by pumping in the south end of the valley. It is estimated that the development will cost $1,726,000, or approximately $29 an acre.

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Number 6

Gang Boxes—Each.

	Cost.	List.	Sell.
P. B. 2	.....	$ 0.90	$ 0.90
P. B. 3	.....	1.35	1.35
P. B. 4	.....	1.80	1.80
P. B. 5	.....	2.35	2.35
P. B. 6	.....	4.55	4.55
P. B. 7	.....	7.30	7.30
P. B. 8	.....	7.90	7.90
P. B. 9	.....	8.80	8.80
P. B. 10	.....	9.60	9.60

Loom Switch Boxes

Single	.....	.30	.30
2-gang	.....	.50	.50
3-gang	.....	.75	.75
4-gang	.....	1.00	1.00
5-gang	.....	1.25	1.25
6-gang	.....	1.50	1.50
W. P. Box, complete with receptacle	.....	4.50	4.50

Letter Boxes.

Letter Boxes	.....	3.00	3.00

Rigid Metallic Unlined Conduit.
Per 100 feet.

Size.	Cost.	List.	Sell.
½ in.	.....	$ 8.50	$ 8.50
¾ in.	.....	11.50	11.50
1 in.	.....	17.00	17.00
1¼ in.	.....	23.00	23.00
1½ in.	.....	27.50	27.50
2 in.	.....	37.00	37.00
2½ in.	.....	58.50	58.50
3 in.	.....	76.50	76.50
3½ in.	.....	92.00	92.00
4 in.	.....	109.00	109.00

Flexible Metallic Conduit and Fittings.

	Cost.	List.	Sell.
⅜", per 100 feet	.....	$10.00	$10.00
½", per 100 feet	.....	15.00	15.00
¾", per 100 feet	.....	20.00	20.00
1", per 100 feet	.....	30.00	30.00
90 deg. ½" Connector, per 100	.....	12.00	12.00
45 deg. ½" Connector, per 100	.....	12.00	12.00
90 deg. ¾" Connector, per 100	.....	17.00	17.00
45 deg. ¾" Connector, per 100	.....	17.00	17.00
⅜" Connector, per 100	.....	7.50	7.50
½" Connector, per 100	.....	7.50	7.50
¾" Connector, per 100	.....	9.50	9.50
1" Connector, per 100	.....	14.00	14.00

The correctness of these suggested selling prices is not guaranteed by the publisher.

PUNCH HERE

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PUNCH HERE

PUNCH HERE

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Journal of Electricity, Power and Gas
ELECTRICAL PRICE INDEX
Number 5

Boxes and Covers.
(continued.)

	Cost.	List.	Sell.
48-S. Flush steel cover for No. 17 box	.....	$10.00	$10.00
48. Flush brass cover for No. 17 box	.....	50.00	50.00
50. Closed steel cover	.....	9.00	9.00
51. Outlet cover	.....	10.00	10.00
50-B. Cover with ⅜" insulated bushing	.....	12.00	12.00
15. Square outlet, switch or junction, straight electric, 4" square, 1⅝" deep, 8 outlets in side and 5 in bottom, for ½" or ¾" conduit	.....	30.00	30.00
1900. Square outlet, switch or junction box for combination gas and electric fixtures, 4" square, 1⅝" deep, 8 conduit outlets in sides for ½" or ¾" conduit and 1 gas outlet in each of two opposite sides for ½" gas pipe	.....	30.00	30.00
22. Open canopy cover for No. 1900 box	.....	20.00	20.00
22-L. Open cover with ears for No. 1900 box	.....	20.00	20.00
23. Closed cover for 1900 box	.....	20.00	20.00
For Nos. 15 and 1900 Boxes.			
35. Open canopy cover	.....	14.00	14.00
35-L. Open cover with ears	.....	14.00	14.00
35-A. Closed cover (raised center)	.....	14.00	14.00
37. Cover for standard push button or rectangular base switches or flush plug receptacles	.....	20.00	20.00
37-A. Shallow cover for standard push button or rectangular base switches or flush plug receptacles	.....	20.00	20.00
38. Cover for 2-gang plate for standard push button or rectangular base switches or flush plug receptacles	.....	25.00	25.00
38-A. Shallow cover for 2-gang plates for standard push button or rectangular base switches or flush plug receptacles	.....	27.00	27.00
52. Cover with ⅜" insulated bushing	.....	18.00	18.00
11-B. Square outlet junction and switch box 4 11/16" square, 1⅝" deep, 8 outlets in sides and 5 in bottom, for ½" or ¾" conduit	.....	40.00	40.00
*11-B. Deep 4 11/16" square, 2¼" deep, 8 outlets in sides and 5 in bottom, for ½", ¾" or 1" conduit. No bottom outlets are provided in boxes for 1" conduit	.....	50.00	50.00

The correctness of these suggested selling prices is not guaranteed by the publisher.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page preceeding

A-1 American Ever-Ready Works of National Carbon Co.. Los Angeles; 755 Folsom St., San Francisco; Seattle.

A-2 Atchison, Topeka & Santa Fe Railway Co..... 673 Market St., San Francisco; 1218 Broadway, Oakland.

B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co..... 5
590 Howard St., San Francisco.

C-1 Century Electric Co..... 3
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... 4
87 New Montgomery St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co..... 579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co..... Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 11
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-7 Economy Fuse & Mfg. Co..... Kinzie and Orleans Sts., Chicago.

E-1 Edison Lamp Works of General Electric Co..... Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 11
441 Golden Gate Ave., San Francisco.

E-3 Electric Agencies Co..... 247 Minna Street, San Francisco; Central Building, Los Angeles.

E-6 Electric Novelty Works..... 533 Mission St., San Francisco.

E-4 Electric Storage Battery Co..... 3
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 11
34 Second St., San Francisco.

F-1 Fairbanks, Morse & Co..... Los Angeles; Portland; 651 Mission St., San Francisco; Seattle; Spokane.

F-3 Federal Sign System (Electric)..... 618 Mission St., San Francisco.

G-1 General Electric Co..... 10
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

G-1 General Vehicle Co..... 1117 Van Ness Ave., San Francisco; 331 Wall St., Los Angeles; British Columbia Electric Ry., Ltd., Vancouver, B. C.

H-1 Habirshaw Electric Cable Co., Inc..... (See Western Electric Company.)

H-2 Hemingray Glass Co..... 11
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 Haller-Cunningham Electric Co..... 428 Market St., San Francisco.

H-5 Hunt, Mirk & Co..... 141 Second St., San Francisco.

H-7 Hurley Machine Co..... 2
New York and Chicago. (See Pacific States Electric Co.

I-2 Illinois Electric Co..... 261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co..... 111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co..... Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 12
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co..... Sunnyvale, Cal.

M-4 Morse Chain Company..... 6
Monadnock Bldg., San Francisco.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland, Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

N-1 Nason & Co., R. N..... 151 Potrero Ave., San Francisco.

N-6 National Carbon Company..... Cleveland, Ohio.

N-2 National Conduit & Cable Co., The..... Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co..... 4
(All Jobbers.)

N-4 New York Insulated Wire Co..... 12
629 Howard St., San Francisco.

N-5 Northwestern Pacific Railroad..... 808 Phelan Bldg., San Francisco.

O-1 Okonite Co. (The)..... 12
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co..... 80 Tehama St., San Francisco.

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 11
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 12
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-6 Pittsburgh Electric Specialties Company..... 202 Aronson Bldg., San Francisco.

P-7 Pittsburgh Piping & Equipment Co..... 12
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The..... 211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co..... 4
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 3
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co..... 3
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Central Bldg., Seattle, Wash.; 815 Newhouse Bldg., Salt Lake City, Utah.

T-1 Thomas & Co., R..... Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company..... Pawtucket, R I.

U-1 United Sheet Metal Works..... 575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company..... St. Louis, Mo.

W-2 Western Electric Co..... Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 Ward-Leonard Electric Co..... 12
Mt. Vernon, New York.

W-4 Westinghouse Electric and Manufacturing Co..... 50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-5 Westinghouse Machine Co..... 141 Second St., San Francisco.

W-6 Westinghouse Lamp Co..... (See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co..... 444 Market St., San Francisco; 1758 North Broadway, Los Angeles.